Effects of Varietal Diversity on Knowledge of Kava (*Piper methysticum*) in the Pacific

A Senior Honors Project Presented to the Faculty of the Department of Interdisciplinary Studies. University of Hawai‘i at Mānoa

In Partial Fulfillment of the Requirements for Bachelor of Ethnomedicine and Plant Conservation with Honors

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April 15, 2017

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Acknowledgments

I would like to express my sincere gratitude to my advisor Dr. Orou Gaoue for the continuous support of my undergraduate research, for his patience, motivation, enthusiasm, and immense knowledge. His guidance has helped me from the beginning to the end of my research and writing of this thesis. I am forever indebted to Dr. Gaoue for choosing to work with me.

I would like to thank the rest of my thesis committee: my co-adviser Dr. Noa Kekuewa Lincoln for his insightful comments and hard questions, and Dr. Michael Thomas for his encouragement and support with this project.

This thesis would have remained a dream had it not been for the many amazing individuals who contributed financially to allow me to conduct research in Vanuatu.

It has been an honor to work with so many people throughout this process and be the recipient of their knowledge. There are many I would like to thank who have contributed to this project. I would like to thank Dr. Vincent Lebot and Jerry Konanui for their valuable insights. I would like to thank the multiple individuals who allowed me to interview them: Jerry Ooka, Dr. Harry 'Skip' Bittenbender, and J.D. Baker, who have offered valuable insight into the world of kava, and to Michael Louze for guiding me in Vanuatu, as well as Hollingsworth Garae for his invaluable translations, assistance, connections, and friendship. I would like to thank Elaine Deering for providing edits of this paper and her countless support throughout my academic career. I would also like to thank the Vanuatu Agricultural Research Center (VARTC) for giving me access to their kava collection and accommodating this research. I extend gratitude to the Vanuatu Cultural Centre for allowing me to conduct research. Certainly, this thesis would not have been possible without all of those who have contributed to my educational endeavors and academic growth over the years. Last but not the least; I would like to thank my family for their unconditional love and support through the ups and downs throughout my academic pursuits.

Abstract

This study investigated ethnobotanical knowledge variation in Hawai'i and Vanuatu, two regions in opposite ends of the Oceanic archipelago known for its distinctive yet interrelated cosmologies that have shaped kava culture and epistemology. The theory of perceptual salience suggests that the more exposure one has to a certain environment, the more one will know about that environment. In this study, this theory was applied in both Hawai'i and Vanuatu to understand the drivers of kava consumption and how exposure to an environment where diverse varieties of kava are grown influences knowledge of kava and selection of varieties for consumption. Data were obtained by free-listing of kava cultivars and through semi-structured surveys. Perceptual salience was determined by location, frequency of cultivars cited, tudey cultivars, and rate of consumption. This study also explored how the dynamics of gender and age affect how much a person knows about kava. The results show that there is no significant relationship between varietal diversity and varietal knowledge. This lack of significant influence of exposure on individual knowledge is due to the high variation in varietal knowledge in Hawai'i. However, there was a significant relationship between the predictors of knowledge, age and region. Specifically, varietal knowledge has more to do with exposure over time, rather than how much exposure one has had to varieties of kava. This study provides insight into how varietal diversity alone is not enough to influence people's knowledge. It also shows how the length of exposure to a given environment better defines how environmental structures affect people's knowledge. This study provides further insight into future pathways as kava enters the global market, which varieties require more attention to ensure their survival, and how exposure to kava varieties over time influences consumption patterns.

Keywords: Kava, epistemology, perceptual salience, ethnobotany, knowledge

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Chapter One: Introduction

Kava *Piper methysticum* is a psychoactive drink that is prepared by grinding the roots of the perennial shrub (Lebot, Aradhya, & Manshardt, 1991). The plant is prepared into a traditional drink by macerating a combination of the lateral roots and stump into a pulp and straining the mixture with cool or room temperature water (Johnston & Rogers, 2006). This drink has been used for millennia throughout the Oceanic archipelago for social ceremonies, relaxation, medicine, and a multitude of other purposes (Lindstrom, Merlin, & Lebot, 1997). Traditional kava beverages are prepared using either dried or fresh kava root (Davis & Brown, 1999) to prepare an aqueous infusion, releasing its pharmacologically active compounds, which are typically found in the starchy base that culminates in a kava infusion. There are six major kavalactones which have been identified from the kava root:methysticin, dihydromethysticin, kavain, dihydrokavain, yangonin, and desmethoxyyangonin. These chemical compounds are regarded as the pharmacologically active components that influence the central nervous system receptors and neurotransmitters (Jhoo, Freeman, Ang, & Mihalov, 2006), thereby producing an anxiolytic effect. Although this study is not about the chemical constituents of kava, these constituents play a key role in what makes the plant applicable to traditional medicine and its importance in the ethnopharmacopeia of many Oceanic islands as well as its major role in consumption.

Kava is grown in more than six different island nations in the Oceania archipelago and is consumed locally and exported to other nations such as the United States to manufacture nutraceuticals. Fiji, Vanuatu, Samoa, and Tonga are the primary kava-exporting countries (Showman et al., 2015). Vanuatu contains the greatest known

variations, and in Hawai‘i there are thirteen cultivars, including seven cultivars not of Hawaiian origin brought to Hawai‘i from various areas of the South Pacific by Vincent Lebot in the 1980’s. This also gives Hawai’i a niche in the market to produce Hawaiian grown ‘awa (kava). Two of these cultivars among the array of cultivars of kava are termed “tuday kava” also known as "tudei," "tudey" or "two-day" kava due to its longer lasting effects than everyday drinking cultivars. In Hawai‘i the tudey cultivars are known as Iwi and Isa; these varieties are traditionally said to be unsuitable for consumption due to the higher concentration in the kavalactone dihydromethysticin, which may cause unwanted adverse effects (Sarris, Adams, & Wardle, 2009). However, these “tudey” varieties have been gaining in popularity due to their sharp, peppery taste and stronger effects. They have been given the name “tudey” because the effects are said to last for “two days.” However, it is challenging to accurately determine how many people are consuming this variety of kava compared to other varieties, how much they consume, and how often they use it (Showman et al., 2015).

Piper methysticum G. Forster (Piperaceae), commonly known as kava, is sought for its “kavalactone-containing roots,” which are the base of the traditional beverage among Pacific Island communities (Applequist & Lebot, 2006). *P. methysticum* is “endemic to Melanesia (Papua New Guinea, Solomon Islands, and northern Vanuatu” (Lebot, 2016). Also in Figure 1.1 evidence suggests that ‘awa in Hawai’i was a relatively late introduction of intentional and unintentional migrations and exchanges of plant materials (Lindstrom, Merlin, & Lebot, 1997). Winter (2004) stated that Hawai`i has lost much of its indigenous cultural knowledge since the time of European contact, because of the effects of colonization and the subsequent repercussions of the influences of foreign

cultures and religions. As a result, `awa has gone from being an integral aspect of daily life in Hawaiian culture to perhaps being one of the Oceanic islands that has suffered the most loss of cultural knowledge related to the plant.

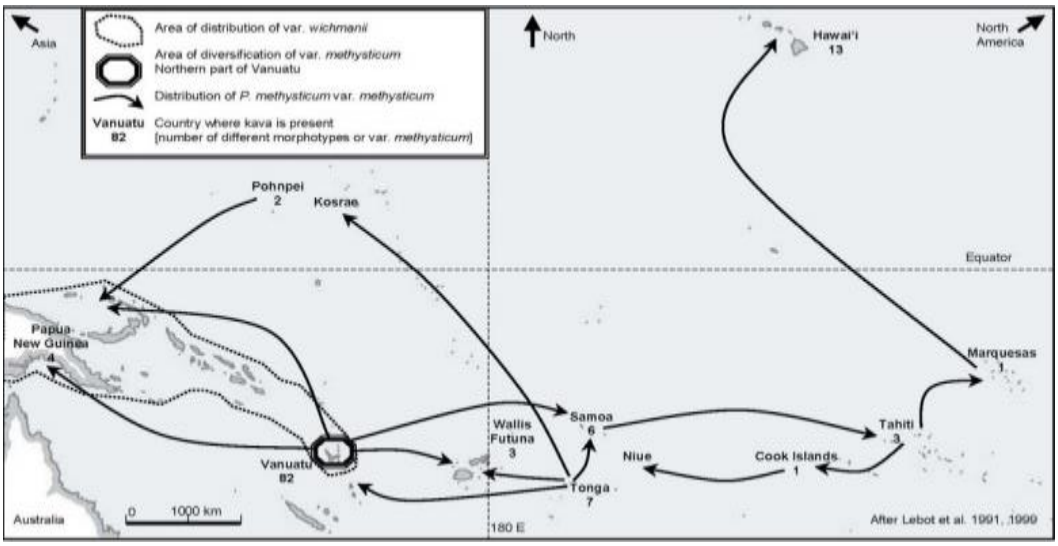

Figure 1.1: The distribution patterns of *P. methysticum var. metysticum* and *P. methysticum var. wichmanii* adopted from Lebot & Simeoni (2004) illustrating the path of the wild *wichmannii* from Papua New Guinea and the center of diversification *P. methysticum var. methysticum* in Vanuatu then is spreading throughout Melanesia, Micronesia, and Polynesia.

Kava plants are usually harvested between 3-5 years, yet may be left growing for more than 20 years. During this time the plants' stumps and roots become larger and other factors influence yield which can include soil type, climate, and plant constitution (Lebot, 1988; Davis & Brown, 1999; SPC, 2001; Nelson, 2011) and anthropogenic activity.

P. methysticum has been of interest to scientific inquiry for over 150 years, beginning in the mid 1800's (Petard, 1826). The first investigations began in Europe in 1860, as stated in Ramzan, & Tran (2004) by Gobley (1860), O'Rorke (1860) and Cuzent (1860 a,b), with the aim to identify the psychoactive constituents and to delineate the

"structure-activity" semblance of the active components, employing kava for the treatment of venereal diseases (Duve, 1976; Showman et al., 2015), and later as a sedative and treatment for anxiety (Showman et al., 2015), eventually preluding to the formative anthropological perspectives (Ball, 1915; Deihl, 1932; and Gatty, 1956).

Several studies have been conducted on the medicinal uses of kava (Alramadhan et al., 2012; Einbond et al., 2017), the nomenclature of chemical composition and effects of kava (Hansel, 1968; Hocart, Fankhauser, & Buckle, 1993; Xuan et al., 2007; Martin, Johnston, Xing, & Hegeman, 2014), the cultural importance of kava (Von Hoerschelmann, 1995; Lynch, 1996; Siméoni & Lebot, 2004; Singh, 2009), the genetic configuration and botanical classification (Lebot 1989; Lebot & Simeoni, 2004), the origin and distribution aspects of kava (Lebot & Lévesque, 1989; Lebot & Simeoni, 2004; and Lynch, 2002). In addition, there have been several published books on the ethnobotany of *P. methysticum* (Lebot, Cabalion, & Benyon, 1988; Lindstrom, Merlin, & Lebot, 1997; Davis & Brown, 1999; Balick, 2009; Singh, 2004; Winter, 2004). However, there have seldom been studies on the dynamics of ethnobotanical knowledge associated with the plant.

Chapter Two: Literature Review

Kava in the Pacific

Kava is an extraordinarily versatile plant that symbolizes artisanal, cultural, political, religious, and social dimensions and developments, and therefore represents an excellent gateway to oceanic societies (Siméoni, Epistemol, & Lebot, 2004, p. 16). There is a rich history associated with the kava plant; it is thought to have first become domesticated about 2500-3000 years ago in Vanuatu, and was ultimately transported throughout Oceania by Austronesian migrants (Lebot et al., 1992). The dualisms between traditional and contemporary dynamics around kava have venerated its place in Oceanic societies; in the same regard kava has transfigured itself into a novel global commodity. Although it has been consumed traditionally for thousands of years (Wang, Qu, Bittenbender, & Li, 2013), it has been "a commodity for over 100 years [and] became much more highly prized on the world market as it became part of a growing fad of 'alternative medicine in the 1990's" (Winter, 2004).

Given kava's widespread history within Oceania, the market for kava was inadvertently decimated in 2002 when kava-containing substances were banned by the European Union (EU) for controversial hepatotoxicity issues (Baker, 2008, 2011; Teschke, Schwarzenboeck, & Hennermann, 2008; Pollock, 2009; Teschke, Qiu, &Lebot, 2011; and Kuchta, Schmidt, & Nahrstedt, 2015). The ban on kava would be overturned nearly eight years later in 2015. The EU ban led to the collapse of the industry and resulted in losses of export earnings just shy of five million U.S dollars in the Pacific Island communities (IKEC, 2004 and Lebot, 2016). Nonetheless, the demand for kava on a regional, national, and international level is increasing. The ban along with the

resurgence of the crop has led to the rise of more regulations and strict standards on kava production and export, at least in Vanuatu, which saw the birth of the Kava Act of 2002 and other acts to distinguish between noble (drinkable) kava cultivars and tudey cultivars. Previous work (by Lebot and Levesque, 1989) created a classification system which assessed the chemical composition and morphological traits to identify different folk taxonomic cultivars and their unique "fingerprint." This has led to the facilitation of the Quality Standard for Kava Export in 2016 with the aim of creating international standards that meet the Codex Alimentarius specifications set forth by the World Health Organization and the Food and Agriculture Organization of the United Nations (PHARMA; MALFFB) using colorimetric coding where "chemotypes are determined by coding the relative proportion of the six major kavalactones representing about 98% of the extract" (Lebot, 2016).

*P. methysticum's "*substantial variability among cultivars, both in morphology and kavalactone composition" (Lebot, Aradhya, & Manshardt, 1991) makes kava a significant multipurpose economical and ethnobotanical crop. We are seeing a resurgence from a socio-cultural and economic standpoint for the Pacific Island communities who grow kava as well as new nutraceutical markets (Baker, 2012), which has tremendous implications on the biodiversity of the plant, the knowledge associated with the cultivars, and sustainability of the value supply chain (Pollock, 2009). These elements are critical in order to have a thriving and sustainable kava industry. Therefore, this study can aid in identifying ethnobotanical knowledge to provide important foresight as a bridge in understanding knowledge gaps, how people interact with their environment, and what

that means in preserving traditions around kava and shifting the paradigm for future markets.

Systematics, Genetics and Chemistry of Kava

Genetic variation in Kava has been clearly differentiated in previous studies, showing that kava *P. methysticum* is derived from the wild species *Piper wichmannii* through anthropogenic domestication and selection. The two taxa are now considered to be a single species with the wild types classified as *P. methysticum var. wichmannii* and the cultivars identified as *P. methysticum var. methysticum*. There are no *P. wichmannii* species in Hawai‘i. Molecular data has demonstrated that all noble drinkable cultivars evolved by the predominance of clonal selection, showing distinct morphology, genetic diversity, and chemical attributes (Vandenbroucke et al., 2015). These distinctions can be classified as different types of kava such as medicinal, noble and ignoble (two-day and wild kava). Noble kava has a long history of safe use as a traditional drink; it has long been used for medicinal purposes by traditional herbalists in Oceania. The “tudey” variety has a very strong effect that lasts two days if drinking excessively; wild varieties are known as “*wichmanni*” (Polyak, Hegeman, Xing, Johnston, & Martin, 2014).

There are six major kavalactones, the main chemical constituents of the plant: “(1 = desmethoxyyangonin, [DMY]; 2 = dihydrokavain, [DHK]; 3 = yangonin, [Y]; 4 = kavain, [K]; 5 = dihydromethysticin, [DHM]; and 6 = methysticin, [M]” (Lebot& Lévesque, 1989; Wang et al. 2010). Tudey and *wichmannii* cultivars are low in (K) and rich in (DHK) and (DHM) (Lebot & Legendre, 2016). The drinkable kavas display great chemical differences from tudey cultivars “by having a much higher proportion of kavalactone (KL), kavain (K), and a near complete absence of a group of chalcones

called flavokavains" (Lhuissier, Mercier, Michalet, Lebot, & Legendre, 2017). Regardless of the cultivar, kava was banned in the global market in 2002 due to controversial hepatotoxicity issues. Most of the health concerns associated with kava have occurred from non-traditional formulations and use (Schmidt, 2003; Teschke, 2010; Teschke, Sarris, & Lebot, 2011; Showman et al., 2015). It has been suspected that Flavokavain B, the major flavokavain, is the potential cause of hepatotoxicity (Zhou et al., 2010; and Lebot, Do, & Legendre, 2014). As noted in Lhuissier et al. (2017) by Dragull et al., (2003) and Jhoo et al., (2006), the health problems reported in the past were a result of increased demand, which may have prompted traders to concoct extracts from non-traditionally-used, and inappropriate plant parts or varieties such as stem peelings and leaves, which have a propensity to accumulate pipermethysticin, a toxic alkaloid.

The ban has had significant repercussions on farm revenue and sales on Pacific Island economies (Sarris, Adams, & Wardle, 2009). Progress is nonetheless occurring, and with the support of governments and a re-emerging kava industry, the practice of rigorous science is in place, and the future of kava among the Pacific Island communities it supports remains optimistic (Sarris, Adams, & Wardle, 2009). The traditional preparation of kava has been part of Pacific Island Communities (PICS) for many millennia. Rightfully so, the temporal scale for which the selection process has endured in conjunction with the prepared drinks' prized traditional value has given rise to a wide variation of cultivars. It would be plausible, then, that the epistemological associations with the abundance of cultivars would also be substantive. It is these associations between the plant and knowledge that this study will investigate.

Conceptual Framework of Perceptual Salience

Salience is a well-studied phenomenon that has emerged fromneuro and linguistic sciences. In this regard, salience "refers to things that are particularly important or relevant and can be easily recognized, are in the focus of attention, or foremost to a person's state of mind" (Chiarcos, Claus, & Grabski, 2011). In MacLeod (2015), the notion of salience is generally described by various authors as an awareness or prominence. Kerswill & Williams (2002) in MacLeod (2015) define salience as "the property of a linguistic item or feature that makes it in some way perceptually and cognitively prominent." As represented in Pedale & Santangelo (2015), overall literature invariably has demonstrated that bottom-up sensory salience increases the likelihood of an object to be successfully selected and then stored in memory. To that degree, they found that complex stimuli in nature scenes that were observed as high salience objects were conducive to a diminished amount of recollected objects. These findings highlight that bottom-up sensory saliency modulates the current contents of working memory in times of retention. Similarly, there is a comprehensive amount of literature that demonstrates the diversity of drivers of salience which could arise from social stimuli (Inderbitzin et al., 2013), value-driven attentional capture (Wang, Yu, & Zhou, 2013), or visual, cognitive, and structural elements that include features which make them more prominent and particularly memorable in the environment (Sorrows & Hirtle, 1999).

"Salience of an element affects its availability in memory, which in turn mediates attributions made concerning that element" (Pryor & Kriss, 1977). In translating this to an ethnobotanical context, then, a plant's unique attributes can arise from many factors--ubiquity, morphology, color, aroma, and taste, which distinguish some plants apart from

others (Etkin, 1994, pp.27-28). In addition, there are other properties attributable to perceptual salience such as wild vs. controlled plant species, toxic properties of plants, irritant properties, or unusual or significant morphological characteristics (Dixon, 1990). These attributes are what Turner (1988) calls "perceptual salience" of a plant; its "obviousness" to people within a culture also influences its importance within that culture. Moreover, these attributes literally become the focal point of selectivity, narrowing and directing anthropogenic attention and experimentation toward certain species and away from others (Etkin, 1994, p. 28).

The basic axiom of the distinctiveness hypothesis is that novel stimuli have a built-in, seemingly automatic capacity to attract attention. In social psychology, salience has been used to predict "distinctiveness" as a contextual variable, often referring to "social category memberships" and "infrequent category memberships" to which the rarity or novelty of a stimulus within a particular context divert the perceiver's attention to the more novel or infrequent stimuli, and the item of interest is then said to be more distinctive. This shows how social salience impacts how one perceives their individual status among their category membership (McGuire, McGuire, Child, & Fujioka, 1978; Taylor, Fiske, Etcoff, & Ruderman, 1978)

The framework for perceptual salience, then, is instructive as to how something such as kava is perceived. This prominence is a function of various levels of interactions. In other words, there are stimuli that act as a trigger, affecting how objects in a given environment are discerned. We can postulate that the mechanisms which drive salience attribution may have to do with how long one has been in contact with a plant, which directly equates to an individual's experience with it. It is a result of past experiences

coupled with repeated exposure to phenomena that elucidate the formation of perceptual salience. Hunn (1982) mentioned that “human perception is programmed to recognize patterns of covariation among the variable dimensions by which perception of a set of objects is organized; the more readily recognized, the stronger the covariation.” Therefore, the theory of perceptual salience suggests that the more exposure one has to a certain environment, the more one will know about that environment. The concept of active and passive exposure is a principal driver in the level of interaction with salience, whereby active opportunity depends on where one is actively involved and how they come into contact with the plants that they learn from. It is not just what is out there from which to learn; it is how one’s daily life molds parameters and constrains one's contacts with the subject from which learning takes place.

The Ethnobotanical Theory of Perceptual Salience

In the case of kava, there are unique circumstances in the salience of a kava plant. Potency (kavalactone content) is one characteristic selected for consumption by humans and attributes to a cultivar's "distinctiveness” or saliency matrix. Kava is unusual due to the plant's somatic mutation and its tendency to create mutants outside of the selection process. Thus, there is a probability factor in that what cultivar is chosen may unintentionally create new accumulations of plant-based knowledge. For instance, even if cultivars vary between each other by morphology, they may have different olfactory characteristics and potency profiles. In this way, “existing knowledge generates new knowledge, typically in a linked or linear manner" (Etkin, 1994). The ethnobotanical adaptation of the theory of perceptual salience cannot rely on distinctiveness or

obviousness alone. As seen in Figure 1.2 which analyses how changes in environmental composition or state can affect knowledge and knowledge dynamics.

In the case of kava, the environment influences the development of new niches or cultivars. There is a parallel relationship that reflects how the environment not only shapes the plant but the plant needs the interaction of the person in order to continue to survive, and the environment is the main driver between the two.

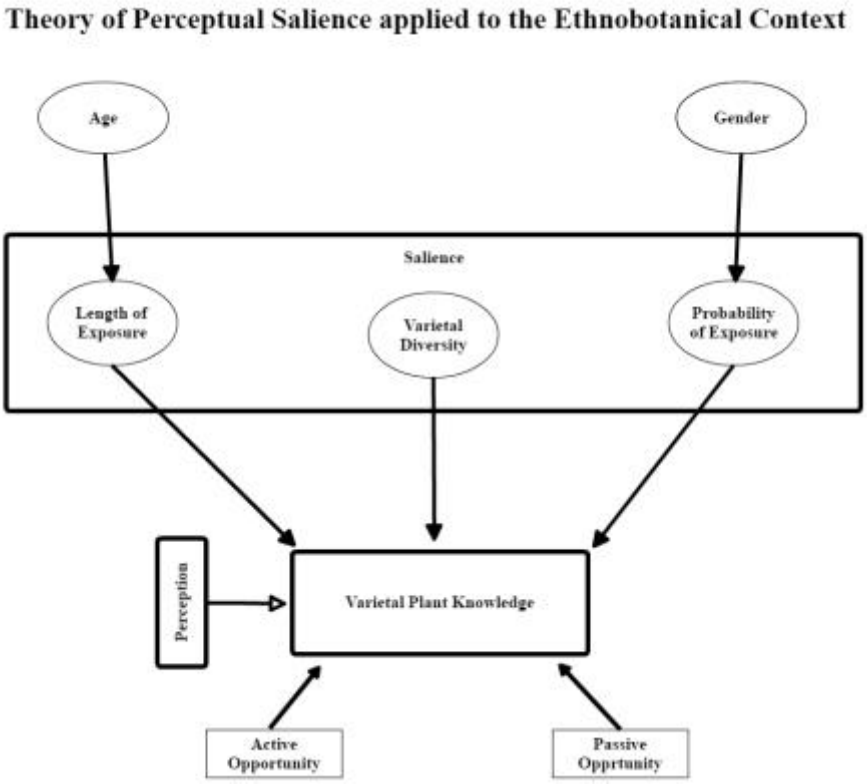

Figure 1.2 A model for Ethnobotanical Theory of Perceptual Salience

Chapter Three: Purpose and Objectives

Application of the theory of perceptual salience in medical ethnobotany is limited in the literature. A limited number of studies investigated psychoactive plant knowledge but our understanding of how key environmental drivers shape local people's knowledge is still limited. The overarching purpose of this study was to explore and understand the ethnobotanical knowledge of kava in Vanuatu and Hawai'i. To achieve this purpose the following research objectives guided this study: (1) Does the environmental context affect people's knowledge of kava? (2) How do age, gender, and demographics affect the influence of varietal diversity on people's knowledge?

I predict that in places such as Vanuatu that has high diversity of kava cultivars, local people would reflect a higher rate of knowledge about those cultivars. I also hypothesized that the level of global (outside) exposure to cultivars from other islands would be a driver of higher retention of cultivars knowledge. In other words, the outside influence increases the number of cultivars a person can learn from. On the contrary, I expected that in Hawai'i, knowledge of cultivars would be considerably lower for two reasons: (1) the number of cultivars a person can pull from is rather constant and small, and (2) kava has a history of displacement in Hawaii which has caused its use to dissipate due to Western influence and misconceptions of 'awa, which has driven the acculturation of indigenous Kanaka Maoli, causing immense influence on the socio-political structure (Patrinos, & Perry, 2010).

Understanding how salience of the knowledge environment influences local knowledge dynamics is potentially mediated by the cultural and historical context among these regions, the dynamics of age and demographics between them and gender are

parameters which could all play prominent roles in how the etiology of ethnobotanical knowledge flows across space and time. The following questions were analyzed in order to understand the ontology of perceptual salience and to test how this theory informs kava knowledge systems across the Pacific: Due to the high number of varietal diversity in Vanuatu, do people tend to know more about kava? Is the lack of effect of varietal diversity on people's kava knowledge due to the effect of provincialism or regionalism masking such effect? Does the number of varieties of kava known by participants differ between regions? Do people know more tudey cultivars than noble (drinkable) kava?

From a scientific perspective, this study contributes to the literature on the theory of perceptual salience and its adaptation in Ethnobotany. Alternatively, it serves to promote understanding of indigenous knowledge systems by providing insight into how exposure to different elements influences emic and etic perspectives of individuals or communities of people in their environment. Specifically, this study will inform how components of a knowledge system changes, are similar, or directs pedagogical outcomes for areas such as conservation and botanical-cultural-ecological preservation. Scientific inquiry of kava also provides insight into the relationships between plants and people, and further insights into the phenomenon of how the cultural importance of a particular plant based on its salience can influence classification systems and how these systems evolve, potentially how they are used, and how likely an individual may select certain plants. From a utilitarian standpoint, this study provides insight about the elements that drive knowledge which can be critical in the value supply chain--the local and global market around kava, and the bilateral trends that sustain it as a culturally important beverage and as a cash crop in a global commodities market.

Chapter Four: Materials and Methods

Study Sites

Hawaii and Vanuatu are ideal places to examine perceptual salience of kava. In Vanuatu, kava is an integral part of kastom, and kastom is integral to the daily aspects of traditional culture. A study byMcCarter and Gavin (2013), which investigated traditional ecological knowledge (TEK), mentioned that TEK informs conservation efforts and quoted Bradacs et al. (2011), saying that "TEK encapsulates a large body of ethnomedical practice," and that VNSO (2012) says that it provides a basis for social well-being. Therefore, kava is suggested to be embodied in TEK as well as contemporary knowledge systems. Similarly, Hawaii shares a long history with kava, as previously mentioned, and is important in ceremonial and social environments.

The study locations (Figure 1.3) in Hawai‘i were on the island of O‘ahu and (Figure 1.4) in Vanuatu, Sanma province on Espiritu Santo island, Shefa province in the capitol of Port Vila, Penama province on the island of East, North Ambae and on the island of South Pentecost.Interviews took place in the main neighborhoods of Santo and Port Vila at nakamals and kava bars, as well as in villages and at the local traditional nakamals in Santo, in east and north Ambae, and in South Pentecost.

The Republic of Vanuatu, in the Southwest Pacific (formerly called the New Hebrides), is a Y-shaped chain of islands extending 1,176km in a north-south direction between the equator and the Tropic of Capricorn. The total area of Vanuatu is about 860,000 km², of which only 12,930 km² is land. Its land area comprises about 83 islands, most of which are the summits of mountain ranges rising from the deep ocean floor (DFAT, n.d.; VNSO, 2002). Vanuatu is three-quarters of the way from Hawai’i to

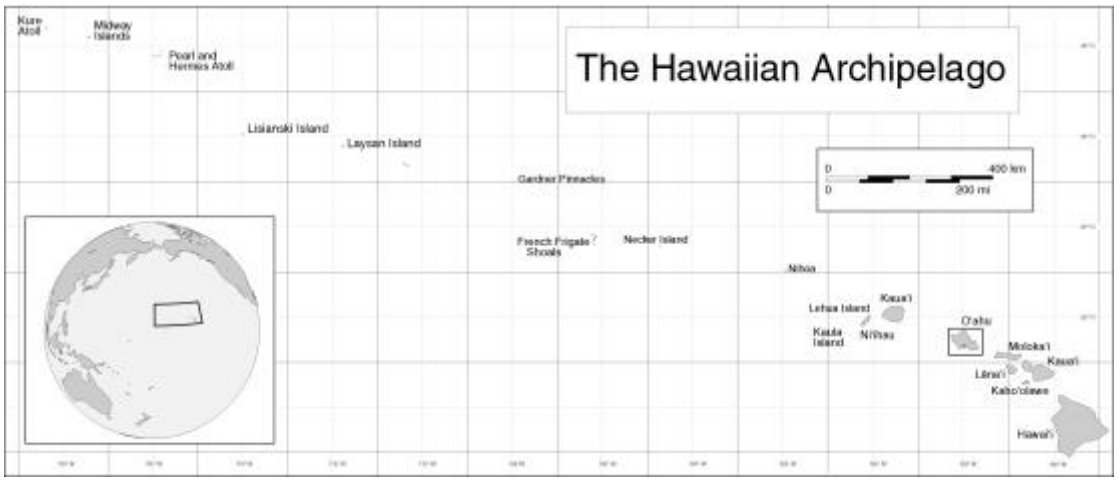

Figure 1.3 Study location outlined (O'ahu) in Hawai'i archipelago which includes the eight major islands and the northwestern Hawaiian Islands.

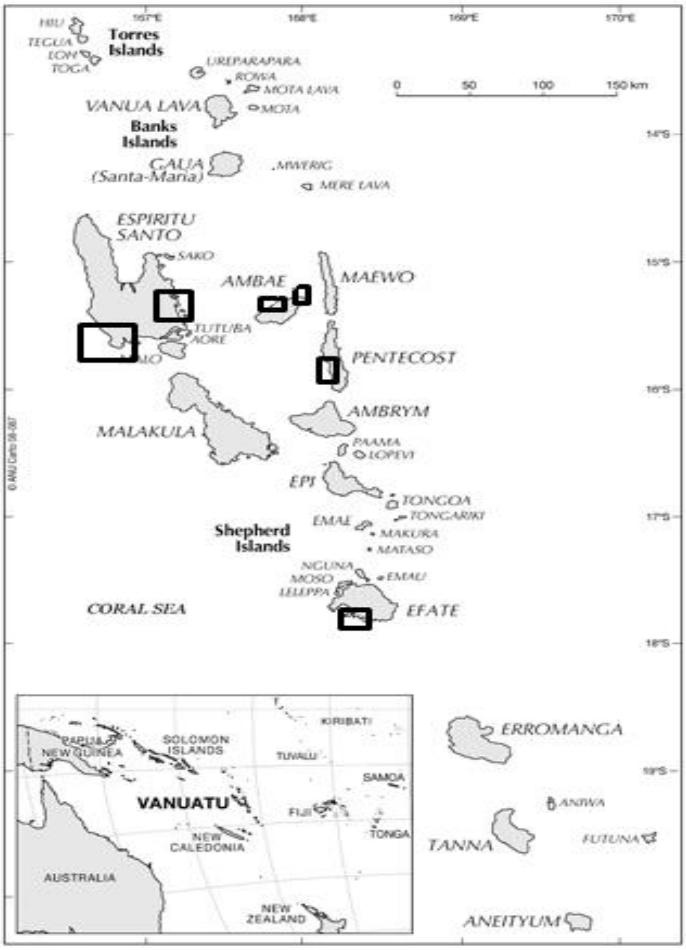

Figure 1.4: Study location in the Republic of Vanuatu shows an outline of the four islands and three provinces involved in this study.

Australia, with a population of 277,554 (July 2016 est.; CIA, 2013), 60% of which is < 25 years old and 70% residing in rural areas. More than 75% of the population is engaged in the agriculture sector, mainly in subsistence agriculture (Costa & Sharp, 2011). The national economy has been expanding since 2003, with an average growth rate of 6% of GDP, led by tourism and construction, and including also beef, copra, kava, and timber. Over 100 languages are spoken in Vanuatu (McCarter & Gavin, 2013), and a vast majority of Ni-Vanuatu are multilingual. Nearly half (49%) of the population speaks at least four languages (VNSO, 2002). This clearly demonstrates from a cultural perspective why there is so much variation in kava cultivars.

The flora of Vanuatu is notable for its "exceptional mixture of natural beauty," comprised of "dense tropical forests on the islands of Santo, Malekula and Efate to the plateau on Tanna Island and green, fertile coastal plains sloping into the blue sea. Natural vegetation covers about 75 % of the country, consisting of “grasslands, secondary growth, and rainforest." However, this natural beauty has been devastated by natural and manmade activities of "cyclones, logging, and subsistence farming," while "the more pristine areas are like botanical wonderlands with 1,500 species of flowering, ferns, shrubs, vines, and trees along with damp cloud forests, and large, moss-covered trees.

Vanuatu’s climate is "wet tropical in the north to subtropical in the south, with much drier rain-shadow areas in between., cooled by "fresh south-easterly breezes" from May to September, which result in "fine sunny days and pleasantly cool nights," followed by the wet season from November to April, featuring "higher temperatures, heavy rains, and occasional cyclones," the heaviest rains occurring from January to March with

occasional “long periods of calm, dry weather during the wet season" and "days of low clouds and intermittent rain in the dry season." Due to variations in latitude and altitude, "the northern and higher islands receive more rainfall than the southern and lower islands" (average annual rainfall of 4,000 mm in the north compared to, “just over half that amount" in the south (U.S. Global Change Research Program, 2014)].

By contrast, the Hawaiian archipelago comprises of a chain of more than 100 islands, atolls, reefs, and shoals extending from the big island of Hawai’i to the Kure Atoll (Olsen, 2004). Its mid-Pacific location "nearly 2,400 km (1,500 miles) from any continental landmass makes it one of the most remote archipelagos on the globe." with a population of < 2 million people and a diversified landscape featuring "as many as 10 ecozones–from alpine systems to tropical rainforests" within a 25-mile area. This ecological diversity supports a high concentration of endemic species (U.S. Global Change Research Program, 2014). Over 130 different languages are spoken in the state (DBEDT, 2016), by over 1.4 million residents (HSDC, 2016).

Data Collection and Sample

This research took place between June and July 2016 in Vanuatu and August 2016-April 2017 in Hawai’i. Our protocol was based on the Code of Ethics of the International Society for Ethnobiology (ISE 2006), and was approved by the Institutional Review Board at the University of Hawaii at Manoa and the Vanuatu Cultural Council. Thirty-three participants were interviewed on the islands of Oahu in Hawai’i and 35 participants in four islands in Vanuatu. Four of the interviewees being exporters of kava who were not included in the general data analysis. For each participant, we recorded their age, gender, if how many varieties of kava they know, what noble or tudey varieties

they know. We also asked questions about the rate of kava consumption, length of interaction with kava, and about potential shortages of kava and value supply chain.

To assess how varietal diversity in a given environment affects participants' varietal knowledge of kava, we conducted a freelisting exercise with participants, where we ask each to list all of the varieties of kava that they could recall. Participants were also asked a series of semi-structured survey questions that was translated in to French and Bislama Vanuatu's national language (see Appendix B). Other questions were asked to provide further insight into the cultural norms that may influence knowledge: What are the reasons why you drink kava? A generalized linear model (GLM) with a negative binomial error structure (because the response variable is a count data with over dispersion: variance greater than mean) was used to test if the number of varieties listed by participants is related to the number of kava varieties in any given islands.

To test the hypothesis that age, gender mediate the effect of islands varietal diversity on participant's varietal knowledge, we used a generalized linear model (GLM) with a negative binomial error structure with the number of varieties freelisted by participants as response variables and the total number of varieties in the island, and the participant's age and gender as predictors. We started with a full saturated model which includes the all the three predictors variables and generated subsequent reduced models removing each predictor one at the time. We used the Akaike information criterion (AIC) to select the best supported models. Qualitative data were ascertained by using thematic analysis outlined by Russel and Ryan (2003), using a compare and contrast approach along with a simplified version of querying data.

Chapter Five: Findings

Distribution of kava varietal knowledge

There was no significant difference in kava variety knowledge between Oahu and Vanuatu (β=-0.170 ± 0.1788, p= 0.34, Figure 1.5b) and also between provinces (Figure 1.5c), even though the total number of varieties between the two is different. People know more "Tudey" varieties in Vanuatu more than in Oahu (β=-0.773 ± 0.344, p=0.025). People know more in Penama than in Efate and in Efate more than in Samna and more than in Oahu. We found no significant difference in knowledge of "Noble" varieties between islands. However, in Vanuatu, *Borogu* and *Melomelo* were the most cited cultivars, and in Hawaii three groups share close relationships in terms of what was most cited: *mahakea*, *hiwa* or *spotted hiwa* cultivars, and those who do not have a preference.

Do people know more variety in places that have more varietal diversity?

We found no significant relationship between the number of Kava varieties that people know and the total number of varieties available on their island (β=0.0145 ± 0.015, p=0.370, Figure 1.5a). Even when we accounted for the effect of age and gender, we found no significant effect of varietal diversity on varietal knowledge (β=0.005 ± 0.0167, p=0.741). To test if this lack of relationship is due to the fact that the total number of varieties in Oahu was constant, we ran a model only for Vanuatu which has provinces with different numbers of total kava varieties (Figure 1.5d). We found no significant effect of varietal diversity on knowledge of kava variety (β=0.018 ± 0.013, p=0.155).

Some participants listed kava varieties which are found outside of the island in which they lived. To test if such varietal knowledge which may have been acquired by participants because they have lived elsewhere, we developed a revised negative binomial model with participant's knowledge of local (instead of total) varieties as the response variable. We found no significant relationship between knowledge of local varieties and total number of varieties in the community ($\beta=0.024 \pm 0.026$. $p=0.352$).

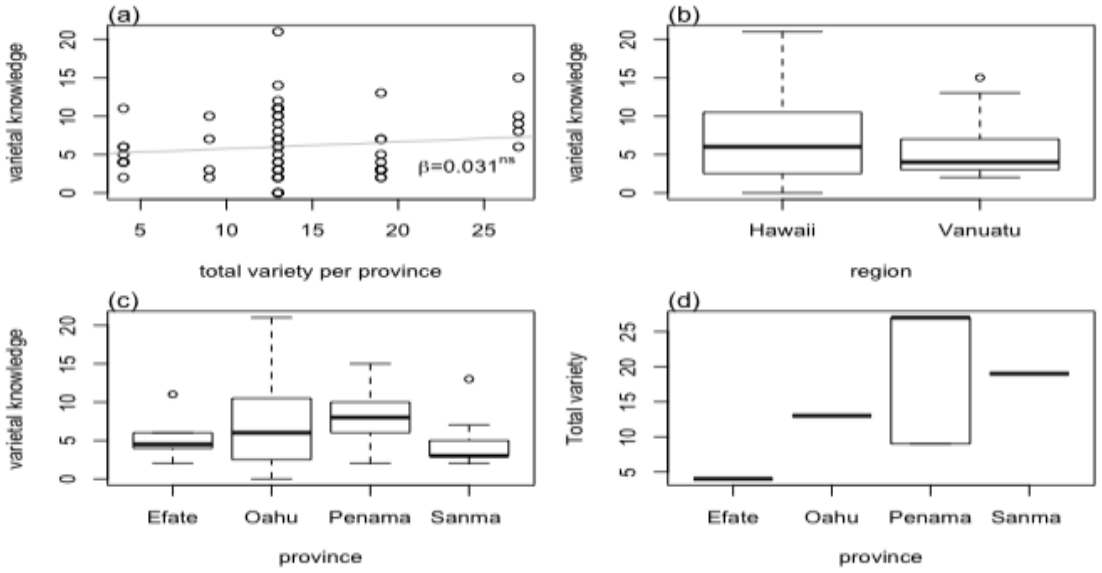

Figure 1.5: Varietal knowledge between regions: Hawaii and Vanuatu, and on a province and island (local) level in Vanuatu.

Age, gender, and dynamics of kava varietal knowledge

The model with only age has the highest support ($\Delta AICc=0$), but the model with an interactive effect of age and region was equally supported ($\Delta AICc=1.8$). Participant's varietal knowledge increased with age, at a faster rate in Hawaii ($\beta=0.013\pm0.006$, $p=0.044$) than in Vanuatu ($\beta=0.010 \pm 0.007$, $p=0.142$), where varietal knowledge did not

change with age (Figure 1.6a). We also found the models which include the main effect of gender (ΔAICc=0.03) and region (ΔAICc=1.54) are the best supported models, suggesting that men have more varietal knowledge than women (β=0.528 ± 0.266, *p*=0.047) in both study regions (β=-0.150 ± 0.173, *p*=0.385, Figure 1.6b).

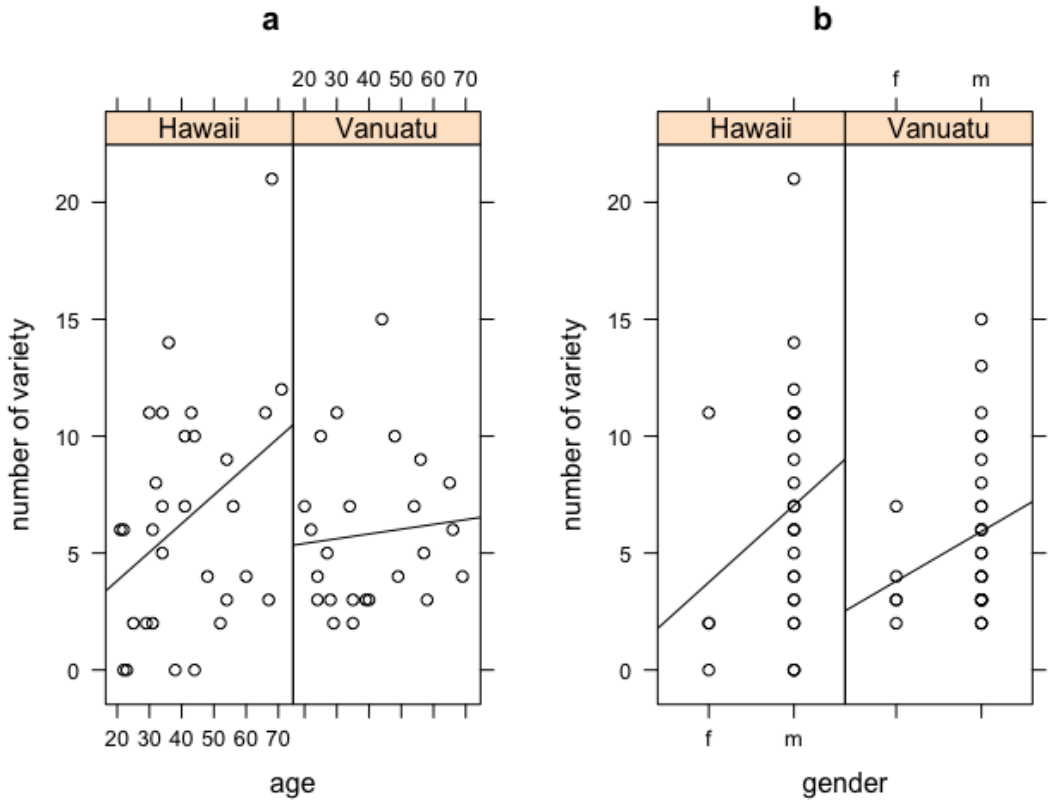

Figure 1.6: Effects of (a) age and (b) gender on varietal knowledge across region.

Chapter Six: Discussion

In this study, we investigated how perceptual salience affects people's knowledge of kava and how the dynamics of age and gender and demographics influence perceived wisdoms of kava cultivar diversity. Here we describe the environmental context which drives plant selection, along with ethnographic interpretations which provide insight into how the socio-cultural role around kava explains the relationships pertaining to knowledge that come into play between Hawai'i and Vanuatu. Contrary to the theory of perceptual salience we found no direct link between the kava varietal diversity in the islands in which one lives with their varietal knowledge. Although we did not find an influence of varietal exposure on knowledge, we found that the length of time an individual is likely exposed to diverse varieties of kava (age effect) or the opportunity the participant had to interact with kava (gender effect) positively drive varietal knowledge.

Various approaches have been proposed to explain how knowledge of plant life is acquired within demographic groups. (de Albuquerque et al., 201; Souto, & Ticktin, 2012; and McCarter& Gavin, 2013). Age and gender are most often believed to exert a strong influence on knowledge about plants, with women and older people credited with having superior knowledge of the medicinal qualities of plants (de Albuquerque et al., 2011). For example, Souto & Ticktin (2012) found significant interactions between age and gender, as important predictors in the acquisition of knowledge which is consistent with our results in Hawaii. These authors showed, consistent to our results, that in many cases men, older people, and local individuals knew significantly more than women, younger people, and foreign individuals. However, in our study we found no significant effect of age on varietal knowledge in Vanuatu. This may be due to the oversaturation of

cultivars in the folk taxonomic system even though they were sorted out by Lebot & Lévesque (1989) there are still a high number of *P. methysticum* circulating around Vanuatu although our results show that regardless of where one is on the age spectrum that they tend to know about the same amount of cultivars. There are instances though where individuals do know more than others with up to 14 cultivars mentioned and as low as 2. Except for gender, there is a wide variation in the epistemological paradigms of age and among demographics both on the local (island) and global (regional) levels. Souto & Ticktin (2012) report that "the dominant epistemological paradigms . . . explain observed phenomena" but "can change over time" to the extent that the concept of "'cultural erosion' could become replaced by more recent ideas linked to adaptability and environmental change". This may be true for certain individuals depending on the context. Notions of kava have been nested in the way people live throughout Oceania, and it is reflected in a social, political and cultural context. Therefore, "change" will take place in a new way with new knowledge being acquired without displacing old knowledge completely. Because there are different dimensions around kava in both traditional and contemporary narratives, how varietal knowledge is retained and redistributed warrants further investigation.

Overall, high varietal diversity did not instantiate kava varietal knowledge in our study areas. The distinctiveness hypothesis by McGuire, McGuire, Child, & Fujioka (1978) and Taylor, Fiske, Etcoff, & Ruderman (1978), posits that salience is driven by novel or infrequent stimuli that is on the periphery of our perception. They point out that the context of an individual's status shifts as they form memberships in new, unfamiliar categories. This new interaction or stimulus is said to prompt salience. Oakes & Turner

(1986) suggest that there is no support for this hypothesis and that novelty does not predict categorical membership. In our study one would expect that with the abundance of kava cultivars individuals would react to change by forming new memberships, yet we found no evidence to support this theory. It was expected that more varietal knowledge would be prevalent in Vanuatu because of the long history, cultural significance, and abundance of cultivars. However, as noted we found no link to suggest that higher varietal diversity equates to acquisition of new knowledge. Although noble is a term associated with Vanuatu kava, it is used interchangeably here for cultivars that are suitable for everyday consumption. We found are fewer tudey cultivars available in O‘ahu and significantly less is known about that cultivar in Hawai’i than in Vanuatu, even though the numbers of noble varieties do not vary between regions. This might be due to the fact that some people have experience with other varieties of kava from other islands; as a result, they tend to know far more than their limited exposure to them would lead one to expect. There is no known link between the number of local kava cultivars on a given island and the influence of outside knowledge. Also, men tend to know more kava cultivars than women. These findings suggest that opportunity is key; there are two kinds of opportunity: active and passive. And passive knowledge does not lead to practical use of that knowledge. Rather, it stems from the type of exposure and how that exposure to kava is influential in a person's acquisition of knowledge.

Choice must be informed by some knowledge system and what the drivers of knowledge are. If we know how active or passive exposure drives knowledge, we can make informed decisions on how to increase this knowledge and apply it to global education. Thus, it is desirable to determine the extent to which the local environment or

the academic environment influences and sustains knowledge. Knowledge derived from one's local environment can be used as a driver of knowledge to increase people's knowledge of a given product from a practical standpoint, to tell us about the products that people consume.

The level of interaction and not the mere exposure to outside influences determines one's knowledge. As an example, the Vanuatu people know more about tudey due to their high level of involvement with this substance. Passive learning involves no interactive experience and limits knowledge acquisition. Therefore, the number of varieties of kava on a given island and the varieties one has learned about show no direct relationship with outside knowledge. Hanazaki, Herbst, Marques, & Vandebroek, (2013) concluded that "[d]eclining knowledge due to disruptions in the social transmission of knowledge between generations has been widely reported in ethnobotanical studies." Our findings show that the value supply chain around kava has been and continues to change and this, coupled with the social dynamics associated with kava may play a role in what is considered important to be salient. For example, many participants in Vanuatu cited two cultivars, "Borogu" and "Melomelo," which incidentally have seen a wave in popularity as it has been pushed by the Vanuatu government, exporters, and often is now found in a majority of the nakamals and kava bars in the region.

Perceptual salience as proposed by Hunn (1977) and applied by Berlin, Boster, and O'Neill (1981), and later integrated by Turner (1988), whom found support for perceptual salience. MacLeod (2015) found conflicting results that the criteria and approach matters in how they better align with different types of studies. This study found no support for perceptual salience as conceived generally, which is that an

individual's environment defines what one knows particularly through a passive process of being exposed to it. The results suggest that opportunity is fundamental to active learning, and that one's location would not determine knowledge, but rather the type of environment one is in. Therefore, one's activity is measured by the level of interaction with the environment rather than the type of exposure.

Concluding remarks

Structures that are being built around kava are impacting knowledge and changing the knowledge structure. In Vanuatu, we did obtain perspectives from indigenous knowledge where village life is still prevalent and "kastom" is still in practice. The avenue of epistemological acquisition of indigenous knowledge may be contrived differently than those residing in the urban areas of the country and other factors may influence knowledge such as the economic, political, and social practices and their emic understandings of the environment around them. This is also something that could be looked at specifically in Hawai'i as well. Interestingly, the shift from the saturation of cultivars to a distinction between noble and tudey cultivars has resulted in "noble recommendations." This is in part why two cultivars are popular. The theory of perceptual salience says that if you're engaging with something, then you are going to have more knowledge of it, which implies that people who are drinking kava would have more knowledge of it as opposed to non-drinkers who do not have that perceived salience. The aim of this study was to validate perceptual salience on ethnobotanical knowledge, and kava was a perfect plant for this. With the emergence of new epistemological facets around kava, as cultivars from the folk taxonomic system fade, there will be some loss of the ethnobotanical stories associated with other cultivars.

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Appendix A

University of Hawai'i

Consent to Participate in Research Project:

Effects of Varietal Diversity on Knowledge and Consumption of Kava (*Piper methysticum*) in the Pacific

My name is Andrew Gerren, I am an undergraduate student at the University of Hawai'i at Manoa in the Department of Interdisciplinary Studies studying Ethnomedicine and Plant Conservation. I am doing a research project involving the use of different varieties of the kava plant. I am asking you to participate because you either produce or drink kava. This studyis looking at kava in Hawai'i and Vanuatu observing how kava varieties are important by talking to farmers and producers, kava distributors, and to the outlets (kava bars/nakamals) and people who drink kava and is looking at patterns in kava varieties and what makes certain varieties better for production or preferred for drinking. This will help understand future pathways for kava entering the world market and also provide information on which kava varieties need more attention to ensure their continued production. This will also provide knowledge on how people select plants for local uses and how variety and diversity can impact the choices they have.

Activities and Time Commitment: If you participate in this project, I will meet with you for an interview at a time and place convenient for you. The interview will consist of 5-10 questions such as "What kinds of kava are you growing?" or "Do you prefer drinking one variety over another?" Additional questions may be asked according to conversation and various experiences each person has with kava. The interview will take from 10-20 minutes to an hour to complete. With your permission I will audio-record the interview so that I can later transcribe the interview and review your responses. You will be one of about 30 people in Hawai'i and 30 people in Vanuatu whom I will interview for this study.

Benefits and Risks: There will be no direct benefit to you for participating in this interview, but the information I obtain might be useful for farmers or producers of kava and the local economy. There is little risk to you in participating in this research project other than the time you will spend in the interview. If you become stressed or uncomfortable answering any of the interview questions, you may skip the question, take a break, or stop the interview.

Privacy and Confidentiality: I will keep all information in a safe place. Only my University of Hawai'i advisors and I will have access to the information. Other agencies as well as the University of Hawai'i Human Studies Program have the right to review research records. After I prepare a transcript of the interviews, I will store the interview material in a secure location and will erase or destroy the audio-recordings after 3 years. When I report the results of my research project, I will not use your name or any other personal identifying information unless you give me permission to do so. If you prefer, I

will report my findings in a way that protects your privacy and confidentiality. Before we begin our interview, I will ask you whether you wish to proceed.

Voluntary Participation: Your participation in this project is completely voluntary. You may stop participating at any time without penalty.

Questions: If you have any questions about this study, please call or email me at [phone (954) 515-6324 & gerrena@hawaii.edu]. You may also contact one or both of my advisers, Noa Lincoln at [phone (808) 956-6598 &nlincoln@hawaii.edu] or Orou Gaoue, at [phone (808) 956-6704 & ogaoue@hawaii.edu] or Dr. Michael Thomas at [phone (808) 956-4168 & mbthomas@hawaii.edu]. If you have questions about your rights as a research participant, you may contact the UH Human Studies Program at [phone (808) 956-5007 or uhirb@hawaii.edu].

If you agree to participate in this project, please sign and date the signature page below:

Please keep the section above for your records.

If you consent to be in this project, please sign the signature block below.

Tear or cut here

Signature(s) for Consent:

I give permission to join the research project entitled "*Effects of Varietal Diversity on the Selection of Psychoactive Plants in the Pacific."*

Please initial next to either "Yes" or "No" to the following:

_____ Yes _____ No I consent to be audio-recorded for the interview portion of this research.

_____ Yes _____ No I give permission to allow the investigator to use my real name to be used for the publication of this research.

Name of Participant (Print):_____

Participant's Signature: _____

Signature of the Person Obtaining Consent: _____

Date: _____

Appendix B

Questions for farmers/producers:

1. Can you list all kava varieties that you know?
2. What is the name or names of the kava you grow?
3. Why do you choose to grow this kava?
4. Which varieties do you prefer, can you rank them?
5. Why do you prefer these varieties?

Questions for distributors:

1. What variety do you distribute the most of?
2. Do you have data about the distribution of the different varieties of kava that you distribute?
3. If one variety - do you blend your kava, if so what varieties? Do you know the proportion of your blend?
4. Why do you choose your variety?

Questions for kava bar/Consumers

1. Can you list the varieties you know ?
2. What variety do you prefer?
3. What do you like about drinking kava or the variety you choose?
4. How long have you been drinking kava?
5. What purpose do you drink kava for? E.g. Tradition, medicine, or social?

General Question:

1. Do you know tudei varieties?
2. **Farmer:** Do you grow tudei varieties? **Distribution:** Do you distribute tudei varieties? **Consumers:** How often do you use it
3. Why do you use that?
4. With kava re-entering the global market do you think that there will be a shortage to the local and/or global market?
5. If yes, what can people do to ensure the supply of kava?